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(72) Inventor: KENNETH JOHN TAYLOR

(19)

(54) PROCESS FOR PRODUCING THERMOPLASTIC MOULDING COMPOSITIONS

(71) We, TBA INDUSTRIAL PRODUCTS LIMITED a Company organised under the laws of Great Britain, of 20 St. Mary's Parsonage, Manchester M3 2NL (formerly of 77 Fountain Street, Manchester M2 2EA), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to a process for producing thermoplastic moulding compositions containing more than one filler and/or fibrous reinforcing agent.

It is known that compounding-screw machines, such as screw extruders, injection moulding machines and mixers, can be used to compound a particulate fillter or fibrous reinforcing agent with a plasticized mass of thermoplastic polymeric material. Different fillers and reinforcing agents have different mechanical strengths and physical properties, and hence the operating parameters of such a machine must be changed when a batch of one thermoplastic material with one type of fillter or reinforcing agent is changed for another batch of thermoplastic material with a different filler or reinforcing agent. This problem is accentuated when it is desired to compound a thermoplastic material with two fillers or reinforcing agents of different mechanical strengths and/or physical properties.

According to the present invention, a process for producing a thermoplastic moulding composition comprises:–

(i) feeding to the barrel of a compounding screw machine, at a relatively upstream location, a component which is a relatively difficultly dispersible particulate filler of fibrous reinforcing agent;

(ii) separately feeding to a relatively downstream location a component which is a relatively easily mechanically degradable particulate filler or fibrous reinforcing agent; and

(iii) simultaneously with (i) and (ii), supplying a thermoplastic polymeric material to the machine and operating the machine to disperse both said components through the thermoplastic polymeric material.

Hereinafter reference will be made to 'multicomponent reinforcement' by which we mean a moulding composition additive which consists of (a) at least one component which is a relatively difficultly dispersible filler or fibrous reinforcing agent and (b) at least one component which is a relatively easily mechanically degradable filler or fibrous reinforcing agent, component (a) being referred to hereafter (simply for convenience) as the 'tough' component and component (b) being referred to a as the 'weak' component.

By virtue of this process, it is possible to subject each component to sufficient work to disperse it in the polymeric material but to insufficient work to effect substantial mechanical degradation of either component, particularly the 'weak' component.

The production of known multicomponent reinforcement thermoplastic moulding compositions can involve three (or even more) stages, for example the production of a 'masterbatch' of one of the components dispersed in thermoplastic polymer, the production of another 'masterbatch' of another of the components dispersed in thermoplastic polymer, and subsequently blending in pellet form the two masterbatches thus obtained. By virtue of the present invention it is possible to reduce the production of such a moulding composition to a single stage with reduction in costs.

In a preferred aspect of the present invention, the process comprises:–

(a) providing a compounding screw machine having a barrel length: screw diameter ratio (L/D ratio) of at least 9:1;

(b) feeding thermoplastic polymeric material to an upstream location in the barrel; and

(c) simultaneously with (b), either:–

(i) feeding the 'tough' component to the upstream location and the 'weak' component to a down-stream location, or

(ii) feeding the 'tough' component to a first downstream location and the 'weak' component to a further downstream location.

The machine may be a single screw compounding extruder but preferably is a twin-screw compounding extruder. When a twin-screw extruder is used, the L/D ratio is determined by reference to the diameter of one of the screws; the screws may be rotated in the same direction (i.e. co-rotated) or may be rotated in opposite directions (i.e. contra-rotated). Preferably the L/D ratio is at least 15:1.

The thermoplastic polymeric material may be any melt processable thermoplastic polymer, preferably a polyamide, a polyester (and especially polybutylene terephthalate or polycarbonate), an acetal, polyphenylene oxide, a polyolefin, polystyrene, styrene/acrylonitrile copolymer, acrylonitrile/ butadiene/ styrene copolymer or a mixture of at least two thereof, and may in corporate a processing aid (selected, for example, from stabilisers, plasticizers and lubricants) and/or a modifier (selected, for example, from fire retardant additives, pigments, and the like).

hhe preferred fillers and fibrous reinforcing agents may be classified in groups:

A. Asbestos, talc, dolomite, treated and untreated calcium carbonates, silica sand, carbon black, titanium dioxide, Kieselguhr, anhydrite, glass fibres as milled glass (any one or more of these preferably forms the relatively difficultly dispersible component of the reinforcement);

B. Glass fibres as chopped strang or roving or milled glass, potassium titanate fibres, carbon fibres (these may be considered relatively easily degradable with respect to group A, or relatively difficultly dispersible with respect to group C);

C. Potassium titanate fibres, calcium sulphate fibres natural and synthetic calcium silicate fibres, vermiculite in natural or expanded form, mica (these are relatively easily degradable with respect to Groups A and B).

D. Solid glass spheres – these are both easily dispersed and relatively undegradable (mechanically).

Preferred embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which each of the four figures is a schematic representation of the barrel of a twin-screw extruder, showing the method of feeding thereto the components of a multi-component reinforcement thermoplastic moulding composition.

In all of Figures 1 to 4, a twin screw extruder has a barrel indicated generally at 5, carrying at its downstream end a die 6 for forming the moulding composition into a rod-like extrudate which can, if desired, be chopped into pellets.

In Figure 1, the extruder has an upstream feed inlet 1, a downstream feed inlet 2, and a vent V for venting the barrel; in Figures 2 and 3 there is additionally a further downstream feed inlet 3, and in Figure 4 there is a still further downstream feed inlet4. Vent V is omitted from the embodiment of Figures 2,3 and 4, but if venting is desired, the vent should be located between feed inletes 2 and 3 in Figures 2 and 3 and between feed inlets 3 and 4 in Figure 4. The preferred ranges of L/D ratio for each zone between the neighbouring feed inlets and between the furthest downstream feed inlet and the die, are shown in each of the Figures.

Using the classification A to D for fillers and fibrous reinforcing agents, the designation P for the thermoplastic material, the designation S for supplementary additives (such as, for example, stabilisers, fire-retardants, plasticizers, lubricants, pigments and mould release agents), the following Table outlines programs for feeding all the components to extruders as described above with reference to each of Figures 1 to 4.

Figure	Feed 1	Feed 2	Feed 3	Feed 4
1	P+S+A	B or C	–	–
2	P+S+A	B	C	–
3	P+S	A	B or C	–
4	P+S	A	B	C

Solid glass spheres (group D) may be fed to the extruder at any convenient location, having regard to the possible effect of their inclusion at any location upstream of the feed of a 'weak' component.

Using the process described above, it is possible to produce compositions of the type described in UK Patent Specification No. 1369589, more efficiently than by the method disclosed therein.

WHAT WE CLAIM IS:–

1. A process for producing a thermoplastic moulding composition, which comprises:

(i) feeding to the barrel of a compounding screw machine, at a relatively upstream location, a component which is a relatively difficultly dispersible particulate filler or fibrous reinforcing agent;

(ii) separately feeding to a relatively downstream location a component which is a relatively easily mechanically degradable particulate filler or fibrous reinforcing agent; and

(iii) simultaneously with (i) and (ii), supplying a thermoplastic polymeric material to the machine and operating the machine to disperse both said components through the thermoplastic polymeric material.

2. A process according to claim 1, comprising:

(a) providing a compounding screw machine having a barrel length: screw diameter ratio (L/D ratio) of at least 9:1;

(b) feeding thermoplastic polymeric material to an upstream location in the barrel, and

(c) simultaneously with (b), either:–

(i) feeding the first-mentioned component to the upstream location and the second-mentioned component to a downstream location, or

(ii) feeding the first-mentioned component to a first downstream location and the second-mentioned component to a further downstream location.

3. A process according to claim 1 or claim 2, wherein the compounding screw machine is a twin screw extruder and the screws are co-rotated.

4. A process according to claim 1 or claim 2, wherein the compounding screw machine is a twin screw extruder and the screws are contra-rotated.

5. A process according to any one of the preceding claims, wherein the compounding screw machine has a barrel having an internal length to diameter ratio of at least 15:1.

6. A process according to any one of the preceding claims, wherein the thermoplastic polymeric material is selected from polyamides, polyesters, acetals, polyphenylene oxide, polyolefins, polystyrene, styrene/acrylonitrile copolymers, acrylonitrile/butadiene/styrene copolymers and mixtures of at least two thereof.

7. A process according to any one of the preceding claims, wherein the thermoplastic polymeric material incorporates a processing aid.

8. A process according to any one of the preceding claims, wherein the thermoplastic polymeric material incorporates a modifier.

9. A process according to any one of the preceding claims, wherein the relatively difficulty dispersible component is selected from asbestos, talc, dolomite, treated and untreated calcium carbonates, silica sand, carbon black, titanium dioxide, ieselguhr, anhydrite, and glass fibres as milled glass.

10. A process according to claim 9, wherein the relatively easily degradable component is selected from glass fibres in the form of chopped strand or roving or milled glass, potassium titanate fibres, carbon fibres, calcium suphate fibres, natural and synthetic calcium silicate fibres, vermiculite in natural or expanded form, and mica.

11. A process according to any one of claims 1 to 8, wherein the relatively difficulty dispersible component is selected from glass fibres in the form of chopped strand or roving or milled glass, potassium titanate fibres and carbon fibres, and the relatively easily degradable component is selected from potassium titanate fibres (when these are not present as the relatively difficulty dispersible component), calcium sulphate fibres, natural and synthetic calcium silicate fibres, vermiculite in natural or expanded form, and mica.

12. A process according to any one of claims 1 to 8, wherein one of the components comprises solid glass spheres.

13. A process for producing a thermoplastic moulding composition, substantially as hereinbefore described with reference to any one of the Figures 1 to 4 of the accompanying drawings.

14. A thermoplastic moulding composition whenever produced by a process as claimed in any one of the preceding claims.

15. Mouldings made from a composition as claimed in claim 14.

B. D. P. WETTERS
Chartered Patent Agent
Agent for the Applicants.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

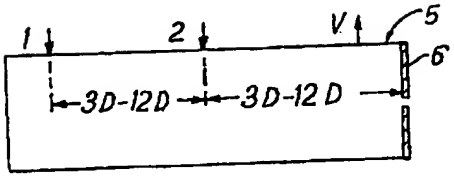

FIG. 2

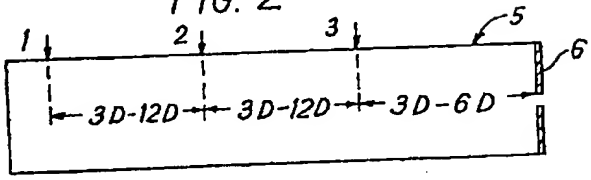

FIG. 3

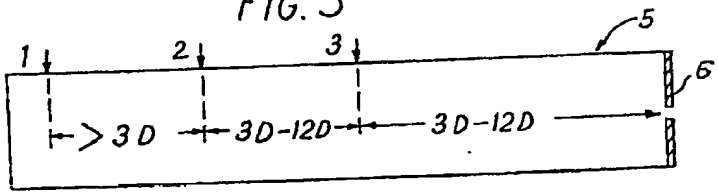

FIG. 4